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THE EFFECT OF 200 MILE LIMITS ON FISHERIES MANAGEMENT IN THE NORTHEAST ATLANTIC

by

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Abstract

The extension of fishing limits in the Northeast Atlantic has led to a fall in the catches by distant water fleets, but has resolved few of the management problems. This is because most major stocks are shared between coastal states so that bilateral or international agreement is still needed on their management and on the allocation of property rights. The distribution of catches and the migrations of the major stocks are described briefly in order to illustrate the interrelated difficulties of management and allocation which have been encountered. The uses and limitations of bioeconomic models in helping to clarify and resolve these issues are discussed. It is not yet clear what form the new management institutions for the Northeast Atlantic will take and the EEC, whose members are committed to a common fisheries policy, poses special problems. A regional council structure is suggested for providing management advice which takes account of the economic and social needs of the fishing industry as well as the conservation of the stocks.

CONTENTS

Page No.

1. INTRODUCTION 1

- 1.1 Regulation 1
- 1.2 Allocation 2
- 1.3 Control 3

2. STOCKS 3

- 2.1 Iceland-East Greenland-Faroe Area (ICES Sub-Area XIV and Divisions Va and Vb 4
- 2.2 EEZ Zone and its Boundaries with Spain and Norway 6
- 2.3 Norwegian Sea, Barents Sea and the Stocks Shared between Norway and the USSR 8
- 2.4 Problems of Stock Allocation 9

3. MANAGEMENT 10

- 3.1 Use of Biological Models 10
- 3.2 Use of Economic Models 11
- 3.3 Management Institutions 12
- 3.4 Provision of Scientific Advice 13
- 3.5 The Need for New Institutions 14

4. REFERENCES 16

1. INTRODUCTION

Exclusive economic zones (EEZ's) out to 200 miles have now been established by most coastal states in the Northeast Atlantic. This development was precipitated by (a) lack of clear outcome to UNCLOS (b) limit extension in the Northwest Atlantic by Canada and the U.S.A. (c) limit extension by Iceland (d) continued heavy pressure on stocks. The declared intention in extending limits often emphasizes the need to ensure proper conservation by assuming ownership, i.e., lack of faith in existing international control and management and in the open access situation generally. The example set by Iceland may have been misleading to other coastal states in the Northeast Atlantic, because it is an island out on its own with few shared stocks. Other coastal states have not acquired exclusive property rights over stocks by extending their limits because most major stocks migrate between EEZ's. Many species of fish migrate over wide areas for feeding and spawning and the eggs and larvae may be carried long distances by currents to nursery areas which often lie within the coastal waters of another country. Cooperation over their management is, therefore, still required. The European Economic Community (EEC) poses some special problems because it is committed to a Common Fisheries Policy giving equal access to its members.

With the change in fishing limits the means of regulating fisheries and the management institutions have also changed, but in many respects the immediate problems are the same.

They can be grouped into:

1. Regulation - aimed at conservation of stocks and improvements in their exploitation ("improvements" judged on several criteria - economic, social, etc.).

2. Allocation - between coastal states and others.

3. Control - the means of enforcing 1 and 2.

The following is intended to give some idea of the likely effects of extended limits on the management of fish stocks, the proportion of fish stocks in the Northeast Atlantic which migrate across EEZ's or beyond 200 mile limits and the kinds of problems which may result from differences in life history between the major species, their varied patterns of exploitation and the types of regulation applied to them. Stocks in the Baltic and in the area off Portugal (ICES sub-areas II and IX) have not been considered here.

1.1 Regulation

Regulations for conserving fish stocks and improving their exploitation depend in the first instance on assessments based on adequate data. For the Northeast Atlantic the data are generally adequate though there may be difficulties - not discussed here - about interpretation, but for areas where this is not the case little progress can be made until more data are collected.

The danger in allowing stocks to remain common property, with unrestricted access, is that fishing effort may rise above the level which gives the highest sustained yield, may impair replacement of the stock and is almost certain to lead to economic wastage. If action is taken to restrain fishing effort in the open access situation, there is no guarantee that the benefits will accrue to those who practice restraint.

National ownership by extension of limits means that the possibilities of restricting access to the stock are increased and future benefits may be better safeguarded. Economic studies can allow for likely future earnings and structural planning of fleets and support facilities can be carried out with greater confidence but there are several important provisos:

1. There may still be conflicting interest groups within a country.
2. Restrictions on access requires the limiting of fishing effort by the nation's fleet as well as limiting outsiders, there may be legal or social obstacles to this.
3. At least in the Northeast Atlantic most major fish resources are shared by more than one coastal state because they migrate. The exploitation in one area will affect that stock throughout its area of migration.

In spite of the provisos the emphasis in regulation is likely to shift from primarily biological objectives (e.g., maximum sustainable yield (MSY)) to include economic and social criteria and from being concerned with short-term management of stocks (e.g., annual catch quotas) to longer term restructuring of industries.

As a result of the extension of limits in the Northeast Atlantic and the shifts in management, several changes have already taken place in the scientific advice required:

1. More species have come under regulation - by means of total allowable catch (TAC) - and virtually all areas inside 200 miles are now covered.
2. More information and scientific advice is being requested on distribution of catches and on migration and life history of stocks in order to resolve allocation problems.
3. In an increasing number of areas fishing vessels are being required by law to provide more information on their activities, often by means of logbooks. The logbooks may be used to calculate catch rates and may lead to more precise forms of effort restriction.

All of these have added considerably to the burden on the working groups of the scientific advisory body for the area, ICES (International Council for the Exploration of the Sea).

It is likely that at least for the next few years the main means of control of the level of exploitation will continue to be through catch restrictions (TAC's) and that allocation between countries will be by quotas. These have until now been agreed within the Northeast Atlantic Fisheries Commission (NEAFC) but its future role is uncertain and bilateral agreements between countries have, in some cases, taken its place.

1.2 Allocation

The previous method of allocating national quotas involved some "horse trading" at NEAFC meetings, but was based largely on "historic rights" with some extra allowance for coastal states. Historic rights were generally calculated as some weighted average of the catch over the past ten years. The new situation is quite different, because property rights are at issue rather than just an allowed catch level for one year. There are numerous objections to basing property rights simply on the distribution of catch over the past ten years and in many cases the distribution corresponding to the new EEZ's is not known. Many of the objections will become clearer by looking at examples. The United Nations Conference on the Law of the Sea (UNCLOS) does not seem to have suggested means of resolving allocation problems for shared stocks.

Since exploitation of a shared stock in one part of its area affects the whole stock, nations cannot regulate these stocks independently. There must be common arrangements on TAC's and other conservation measures before allocating among the coastal states involved. Each coastal state will want to ensure that the regulations are adhered to and this may in practice lead to the TAC being divided up into portions for each EEZ (i.e., zone quotas). This is an unfortunate development in many ways (which will become obvious), but it is difficult to see how it can be avoided.

Once the coastal states have divided up the property rights to a stock among themselves each is free to allocate those rights among its own fishermen or to trade them off for reciprocal fishing rights, licence fees or other quid pro quo with third countries. In practice again this makes zone quotas almost inevitable for a shared stock. Historic rights may play some part in negotiations with third countries, but in the Northeast Atlantic it is obvious by now that these will be phased out very rapidly unless there is some trade-off. This is leading to very rapid contraction of distant water fleets.

There are special problems in this area caused by the fisheries policy of the EEC countries and the result is that the pattern of fishing is changing much more rapidly and drastically than it might otherwise do. The fisheries issue is being used as a political lever by the EEC to gain recognition from the USSR and since this has not been forthcoming, all Soviet fishing activity in EEC waters has been stopped. The EEC has been trying to evolve a supranational policy for its member states which encompasses regulation, allocation and control as well as structural and marketing measures.

1.3 Control

- the enforcement of conservation measures such as mesh sizes, closed seasons and catch quotas.

Since one of the main reasons for extending limits was to ensure that conservation measures were properly enforced this is an area in which great changes have already taken place. Most countries will only allow foreign vessels to fish in their waters under licence and there has been a dramatic increase in surveillance and enforcement of regulations. In many cases new and stricter conservation measures have been introduced.

The institution of licences and logbooks, which at present apply mainly to vessels from other countries, mean that catch rates can be monitored more precisely and that catch quotas are effectively controlled by regulating the fishing effort. There are strong indications that similar systems will be instituted within countries as well and that fishing concerns will have to give indications of their fishing plans when applying for licences. The consequences of this kind of control may be far reaching and it is impossible to foresee what they will be. The opportunistic element will be reduced by the extra level of centralized control; the costs of enforecement and bureaucracy, which are already a significant proportion of the national revenue from fishing, will go up. In the case of Canada the question has even been raised "..... if the benefits we can expect to enjoy by shifting to a national, as opposed to the present international, management system will over the long run exceed the additional management costs we must incur." (Munro, 1977). On the other hand better regulation of existing fisheries and planning of future building should increase revenues and pay for some of the extra costs.

The problem of control is a critical one in both international and national negotiations at present, because it is central to the evolution of the new management structures needed since the extension of limits. Unless credible control measures (e.g. uniform enforcement of mesh sizes, observance of by-catch regulations, accurate and timely reporting of catch statistics) are instituted by all the countries concerned there is little hope of avoiding zone quotas and further conflict on shared stocks, which comprise the bulk of the catch in the Northeast Atlantic. Within the EEC it is now the major issue impeding an agreement on the Common Fisheries Policy.

2. STOCKS

Since the terms "population" and "stock" do not have precise definitions and are commonly used in a variety of contexts it is perhaps worth making clear how they will be used here. "Population" will refer to the fish of a particular species living in an area at any one time e.g., North Sea cod, Irish Sea herring. "Stock" implies a greater degree of discreteness as demonstrated by genetic evidence, differences in spawning area and season, migratory paths, meristic data, growth rate, year-class strength and other individual or group characteristics e.g., Manx herring, Mourne herring. (These are the two groups of herring which spawn in the Irish Sea). Thus a population inhabits one area but may consist of several stocks and a stock may migrate or have part of its life history in more than one area. For example, a proportion of the Celtic Sea herring stock is carried into the Irish Sea as larvae and subsequently grows there and migrates out again to the Celtic Sea. During the time they are in the Irish Sea they are part of the Irish Sea population but still belong to the Celtic Sea stock. The important point here is that fishing activity in the Irish Sea affects both the Celtic Sea stock and the Celtic Sea population. We shall only be concerned with direct effects of this kind and not with such things as market interactions and pollution (i.e., "other externalities" in economic jargon).

The populations of most major fish species within the EEZ's of the Northeast Atlantic coastal states consist, to a large extent, of stocks which are shared. Table 1 gives some indication of the extent of this sharing by classifying the major stocks into local stocks, caught almost entirely within one EEZ and shared stocks. The shared stocks may be caught in more than one EEZ or outside as well as inside 200 miles or they may be spread over more than one EEZ during the course of their life history, but are caught mainly in one. This is indicated in the "comments" column of Table 1.

A good idea of the degree of sharing of stocks can also be gained from the species charts in the FAO Atlas of Living Resources (2nd edition) and this should be referred to for details of migrations, nursery areas and spawning areas.

A single species may have stocks in several categories. For example, there are some local cod stocks (Faroese, Icelandic, Irish Sea stocks), some which are caught in more than one EEZ but not outside 200 miles (North Sea stock) and some which are caught outside as well as inside 200 miles (Arcto-Norwegian stock).

In order to give some idea of the degree of sharing which exists, I shall give a general account of the migrations between EEZ's, with emphasis on certain species which illustrate particular problems encountered in allocation and management. The areas around Iceland, East Greenland and Faroe, which will be considered first do not support my general conclusion that most major stocks are shared over more than one EEZ. Since Iceland was the first country in the Northeast Atlantic area to extend its limits to 200 miles in 1975 this may have set a misleading example to other states.

2.1 Iceland-East Greenland-Faroe Area (ICES Sub-Area XIV and Divisions Va and Vb

The populations of fish in Icelandic waters are mainly from local stocks and can, therefore, be managed independently. This includes plaice, haddock, whiting and probably saithe, since the latter shows very little emigration and only occasional significant immigration from Norwegian waters.

The cod population too is mainly local, with no migration from Iceland to Greenland over the last decade, but in some years the eggs and larvae from the spring spawning off the southwest corner drift over to East Greenland. Also, an average of 25 percent of adult East Greenland cod migrate into Icelandic waters to spawn. Part of the ICES sub-area XIV is in the Icelandic EEZ (see Figure 1), but most of the cod catch in the sub-area is taken in Greenland (i.e. EEC) waters. Both Iceland and the EEC can therefore lay some claim to a share of the stock in each others waters although the Icelandic claim, based on occasional drift of eggs and larvae, is a weak one. The EEC claim is rather stronger, because spawning cod account for 46 percent of the total catch of cod in Icelandic waters and the influence of the immigrants from East Greenland may be significant in some years.

The spawning of redfish takes place in deeper water and there may be single stocks of the two species (Sebastes marinus and S. mantella) spread over Icelandic, Greenland, Faroese and international waters. The allocation of catches between the zones is made difficult by the fact that there has been an enormous increase in the catch in Greenland waters in 1975

Table 1. Division of the stocks of the twenty main species in the Northeast Atlantic into "local" (caught almost entirely within one EEZ) and "shared". Underlining indicates major stocks

Species	'000 tons in 1976	Local	Shared	Comments
Capelin	2 996	Icelandic	Barents Sea	Some outside 200' in Barents Sea
Cod	1 855	Icelandic Faroese	Arcto-Norwegian North Sea	
Sprat	900	EEC Norwegian Fiords		
Herring	856	Icelandic Norwegian West-British	Skagerrak North Sea (Atlanto-Scandian)	The Atlanto-Scandian stock was also caught outside 200'
Mackerel	835		North Sea Westerly	
Saithe	700	Icelandic Faroese	North Sea Northeast Arctic	The Northeast Arctic stock is mainly Norwegian
Norway pout	647	Mostly EEC		
Sandeel	520	Mostly EEC		
Redfish	502		Northeast Arctic Sub-areas V and XIV	
Haddock	494	West British	North Sea Northeast Arctic	
Horse-mackerel	354		EEC - Spain	
Whiting	281	West British	North Sea	A higher proportion of North Sea whiting is in EEC waters
Pilchard	158		EEC - Spain	
Plaice	157	Icelandic West British English Channel	North Sea Northeast Arctic	
Blue whiting	108	Icelandic	Westerly	Fishery may develop in EEC waters but stock widely spread
Hake	97		EEC - Spain	
Ling	56	Several		Very little evidence
Greenland halibut	42		Sub-areas V and XIV	
Monk	37		EEC - Spain	
Tusk	36		?	Very little evidence

and 1976 due to intense Soviet fishing effort. The total international catch from sub-areas V and XIV rose from a steady level of around 100 000 tons during the period 1971-1975 to 190 000 tons in 1976 and at the same time the proportion caught in EEC waters rose from around 14 percent to at least 50 percent. The "historic" pattern of fishing has been completely altered, but the new pattern established in 1976 cannot be used as a basis for allocation because the catch at East Greenland consisted largely of younger fish which should not be exploited so heavily if high yields from the stock are to be maintained. In fact the scientific working group has recommended a TAC of 90 000 tons for 1978 and the Icelanders have suggested a figure of 80 000 tons. The issues of overall regulation of the stock and allocation are closely interrelated and negotiations are still in progress.

Greenland halibut are also apparently a joint stock between Iceland and Greenland, but are caught mainly in Icelandic waters in Division Va and on the Icelandic side of the median line in sub-area XIV.

The capelin stock at Iceland spawns all along the south coast and in some years there is significant drift of eggs and larvae towards East Greenland. Until 1976 the entire catch was taken within 80 miles of Iceland but in that year a summer and autumn fishery took 111 000 tons in the Dohrn bank area west of the island. Only a negligible amount is believed to have come from the Greenland side of the median line.

The present herring population at Iceland consists entirely of local stocks of spring and summer spawners. Until 1968 there was also a major fishery on feeding and overwintering shoals of Norwegian spring spawned herring in Icelandic waters, but this has now ceased due to the collapse of the stock. Some changes in the migratory route of this stock were probably due to hydrographic changes.

There is a major blue whiting spawning area to the southwest of Iceland, but it is likely that a large proportion of the Icelandic population originates from outside Icelandic waters (i.e. Faroe or West of Britain).

The main demersal fish population in Faroese waters (saithe, cod, haddock and whiting) are local stocks.

2.2 EEC Zone and its Boundaries with Spain and Norway

The only major species whose populations in EEC waters can probably be considered as quite independent of populations outside EEC waters are flounder, sole, ling, Norway pout and sandeel. Even for these species this may be due more to our ignorance of their migrations and life history than to the real existence of separate stocks. There is at present some doubt about the status and catches of Skagerrak sole, because the catch statistics may have been falsified to evade quotas, and also about migrations of sole across the boundary with Spain. Almost nothing is known about migrations across this southern boundary, but from the distribution of catches and other general evidence it is believed that megrim, hake, red seabream, angler, pilchard, mackerel and horse-mackerel are all shared stocks.

For the most part the populations to the west of the British Isles and in the English Channel consist of local stocks which are not shared, although two major exceptions are the Westerly mackerel stock and the blue whiting. The situation in relation to the boundary with Norway in the North Sea is very much better known, since the stocks in this area have been more fully investigated and subject to more detailed statistical coverage than almost any others in the world.

The North Sea plaice has its spawning and nursery areas in the EEC zone in the southern North Sea, but adult fish move north into deeper water. A fairly small proportion, perhaps 5 percent to 10 percent are caught in Norwegian waters to the west of the Norwegian deeps mainly by U.K. trawlers, but there is no directed fishery by Norway. Out of a total annual North Sea plaice catch of around 100 000 tons as much as 5-10 000 tons may therefore come from the Norwegian zone, but only 20-30 tons is landed by Norway. The effect of allocating 5-10 000 tons to Norway might therefore be to reduce the total North Sea plaice catch unless Norway increases her landings or agrees to allow others to catch her share as part of a trade-off. The single negotiating text of UNCLOS gives coastal states the responsibility for determining the allowable catch within their zones and requires them to promote the objectives of optimum sustainable yield, but it is difficult to see how this requirement can be applied to such a small proportion of the stock. This kind of problem involves allocation, the principle of full utilization and zone quotas, but the solution, which does not yet exist, is likely to be reached pragmatically rather than by the application of principles.

The timing and area of spawning of the major roundfish species in the North Sea (cod, haddock, whiting and saithe) varies, but the general distribution in relation to the boundary between the EEC and Norwegian zones is similar, with all showing a high degree of mixing across it. There is good evidence from tagging experiments that cod and haddock in particular do not mix randomly throughout the North Sea area, but that they return to the same areas for spawning. Nevertheless for assessment and management purposes they have, until now, been considered as single North Sea stocks and neither the EEC nor Norway can therefore consider independant means of regulating the fisheries for them.

There is disagreement at present over the stock structure of spurdogs. The Norwegian view has been that there is only one stock, which extends throughout north European waters, but in spite of this view they have instituted unilateral conservation measures on their own fishery for the past ten years. The opposing view is that there are several stocks but that at least one is shared between the EEC and Norway, so that common measures are needed in either case.

As well as fish of the North Sea stock, the population of mackerel in the North Sea consists of a varying proportion (25 percent-40 percent) from the Westerly stock, which spawns and overwinters in the Celtic Sea. These Westerly fish are mainly taken in the Shetland fishery. The North Sea mackerel overwinter in the deep water of the Norwegian trench and during the first few years of their exploitation (1966-1969) were taken mainly along its southern and western slopes during the autumn. Norwegian national conservation measures reduced the fishing effort in this area and for a period during the early seventies a larger proportion was taken on the eastern side of the North Sea, but recently the balance of fishing has swung back. Again this raises difficulties in agreeing which historic period and stock mixture should form the basis of allocation.

Until 1976 the entire catch from the North Sea sprat stock was taken in the EEC zone. Small quantities taken in the Norwegian west coast fiords were considered to be from the Skaggerak stock. Surveys also indicate that the main distribution of eggs and larvae is within the EEC zone.

The level and pattern of exploitation on the North Sea herring population has altered radically as the constituent stocks collapsed one after another under the pressure of fishing. Since the middle of 1977 there has been a total ban on herring fishing, which may continue for some time, and it is not possible to predict where or when the herring will come back in sufficient quantity for the fishery to reopen. Nevertheless it is useful to examine the changes which took place, since they illustrate many of the difficulties of conservation, allocation and control.

The North Sea herring population consisted of three main stocks, which spawned in autumn or winter off Buchan Ness, on the Dogger Bank and in the Sandettie area of the Southern Bight and in the eastern English Channel, (see the FAO Atlas of Living Resources for details). More recently the main spawning area has been in the Orkney-Shetland area from which larvae are carried across the North Sea to nursery areas in the Skaggerak and along the Danish coast. In their third year the herring leave the nursery areas in the eastern North Sea and join the adult stock on its feeding grounds in the western North Sea, from Shetland to Shields. Spawning concentrations assemble in July and August off Shetland

and used to occur progressively later all the way down the east coast of the U.K., until the the latest spawning in December in the eastern English Channel. The traditional drift-net fishery, which yielded up to a maximum of 700 000 tons a year, took place during these pre-spawning migrations and subsequently the herring of the two northern stocks overwintered in the Skaggerak and in the Norwegian sector of the northeastern North Sea.

During the 1950's bottom trawls were used with echosounders to fish on the feeding and spawning areas and a major industrial fishery also developed on the nursery areas in the eastern North Sea. The drift-net fishery in the western North Sea ceased and countries using this method lost their share of the catch. In the mid-sixties purse-seining, mid-water trawling and pair-trawling were perfected to further spread and intensify the fishing pressure on the stocks and the overwintering areas in the Skagerrak and the Norwegian sector of the northeastern North Sea became a major fishing ground. As a result almost half of the North Sea herring catch in 1965 came from what is now the Norwegian zone.

By 1975 the population had been reduced to approximately 10 percent of its immediate post-war level and several stocks had disappeared from their traditional spawning areas in the central and southern North Sea. The overwintering concentrations in the northeastern North Sea had also fallen to a fraction of their former size and virtually the whole of the North Sea catch now came from the northwestern part of the EEC zone. Ironically the only area in which a North Sea stock of herring was fished throughout 1977 was the Skagerrak.

Since the North Sea herring population consists of several stocks, some of which are shared, the problems of management and allocation are closely linked. It is difficult to base an allocation on "historic catch" because the distribution has varied so much, depending on the state of the stocks. Control of the level of catch in particular areas and at particular seasons (i.e. area or seasonal quotas) should clearly become a major tool of management if the stocks recover sufficiently to be exploited again, but it is difficult to see how this requirement can be reconciled with the present move to allocate catches to each of the nations involved (i.e. zone quotas). The situation may be further complicated if value is taken into consideration since fish for human consumption fetch higher prices than if they are used for fish meal. There is a seasonal fluctuation in the condition and fat content of herring, which also affects their price.

Several issues of wider interest are raised by the migrations and life history of the blue whiting. This small gadoid with a wide range from Spain to northern Norway and Iceland has been lightly exploited until now, with catches exceeding 100 000 tons for the first time in 1976. Our present knowledge is limited - it is not yet known whether there is more than one stock - but it is estimated that a sustainable yield of over one million tons should be possible.

The major spawning areas lie to the north and west of the British Isles and southwest of Iceland but there is some spawning in Norwegian, Spanish, Faroese and international waters. The larvae probably drift northeastwards and juveniles are taken in quite large quantities in the industrial fisheries off the southwest coast of Norway and off southwest Iceland. From about 2-3 years old, the blue whiting undertake an annual spawning migration from their feeding areas in the Norwegian Sea and it is at this time, while the fish are in mainly EEC waters, that they shoal in sufficient concentrations to provide a viable fishery. Since the fish spend a large part of their life in Norwegian waters there is a strong case for giving Norway a share in the exploitation, but this cannot take the form of a zone quota because the fishery is mainly in EEC waters. Mutual access over the whole area of its distribution would have to be agreed for this shared resource. On the other hand it may be argued that a resource is only a resource if it can be used and that the EEC is therefore the main owner of the blue whiting.

2.3 Norwegian Sea Barents Sea and the Stocks Shared Between Norway and the USSR

All the major stocks of the northern Norwegian Sea and of the Barents Sea are shared between Norway and the USSR and only the cod will be dealt with, since the problems with the others are generally similar. The Northeast Arctic or Arcto-Norwegian cod stock makes up the bulk of the cod population in ICES sub-areas I and II. There are also small coastal cod stocks in Norwegian and Soviet waters. The Arcto-Norwegian cod mature between the ages of 6-12 and spawn close inshore along the Norwegian coast in March and April. Eggs and larvae are carried north into the Barents Sea and the nursery areas are widely spread from Spitzbergen to Bear Island, across the Svalbard shelf and along the north Norwegian and Russian coasts. As the fish grow older their feeding and wintering migrations increase and there is a large trawl fishery in the south Barents Sea, at Bear Island and Spitzbergen, on the immature cod 3-6 years old. When the fish mature they start to take part in the spawning migration down the Norwegian coast and become available to the prespawning and spawning fisheries.

The earliest fishery on this stock was a seasonal one on the spawning concentrations, but since the 1920's the trawl fishery in the northern parts of its area of distribution has intensified and altered the balance so that the average age of capture has gradually declined. Taking the stock as a whole there would be several benefits from raising the average age of capture by reducing the mortality on the younger fish,[1] but this would mean reducing the catch in the Soviet zone and the advantages for the stock as a whole are overriden by the need to ensure an acceptable allocation between the two countries.

The Atlanto-Scandian herring has been mentioned when discussing the population of herring at Iceland. The adult stock declined from 10-15 million tons in the mid-fifties to about 5 million tons in 1963-1965 and finally collapsed completely by 1970 due to overfishing and poor recruitment. During the 1960's major changes took place in the migrations and the distribution for spawning and feeding, due to hydrographic changes. The main spawning areas moved progressively north along the Norwegian coast and the feeding areas shifted from north and east of Iceland to the area west of Bear Island and Spitzbergen. As with the North Sea herring, the distribution of the catch in the different EEZ's (Norway and Iceland in this case) varied and there was also a summer fishery in the area of the Norwegian Sea outside 200 miles. There are signs of a recovery in the spawning stock but this will require strict international control until the stock is re-established and its new distribution is known. Since the stock may be liable to capture in the area outside 200 miles the international control will have to be carried out by NEAFC or a similar body. Another species, which is probably taken mainly outside 200 miles and will therefore require international control measures, is the roundnose grenadier.

2.4 Problems of Stock Allocation

The problems for international allocation and control raised by the generally mixed nature of the stocks in the Northeast Atlantic and their variable pattern of exploitation and migration are only beginning to be appreciated. Because the processes of negotiation and search for solutions have only just started, the situation may have been made to appear more difficult and confused than it really is and some aspects, which seem important now, may later be solved easily or avoided.

So far the main criterion in allocation disputes has been the "historic" distribution of catches and enormous effort has been expended in laboratories and statistical bureaux throughout Europe to extract averages for different areas and time periods. If detailed catch statistics are not available it is far too late to think about collecting them now, when a ten year average is needed, but unfortunately there is nothing to stop countries lacking such data from producing estimates, which often give an impression of opportunism rather than accuracy.

The argument that allocation of property rights should be based on average distribution of the biomass of a stock throughout its life history and not just on the contingent distribution of catches over a few years, is a sound one, but rather difficult to operate in practice because of lack of hard figures. If the allocation is to be based on the distribution of stock biomass then should one use catch rate by areas, with some allowance made for mur-

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1/ Benefits include higher yield per recruit, higher and more stable stock and spawning stock level, less dependence on recruiting year classes.

sery areas and spawning areas? This would probably not give acceptable results for a stock such as blue whiting, whose adult catchability is far lower on the feeding areas (mainly Norwegian) than on the spawning areas (mainly EEC).

For areas in which little is known about the distribution of the stocks it may be possible as a first step to do an allocation based on research surveys and to adjust it as more information becomes available. Probably no allocation should ever be regarded as final and, provided the institutional framework exists for making adjustments, this should not have adverse effects on the overall management of the stocks.

3. MANAGEMENT

The extension of limits was partly a result of lack of faith in international fisheries management and frustration with the economic waste which open access to the resources engendered. It was also, of course, to secure national property rights to valuable resources. In a few cases the extension of national limits probably has made fisheries management easier, particularly if fishing effort has fallen as a result, but from the description of the stocks in the previous section it is clear that in the Northeast Atlantic several new problems have arisen and few of the old ones have gone away. To some extent this is because so many of the stocks are shared, which means that international agreement is still needed on how they should be managed. There is a range of new management situations, with some stocks capable of being managed unilaterally, some bilaterally and others requiring international cooperation. The institutions of management will have to adapt themselves to cope, not only with this, but also with the increased number of stocks coming under control and with the changes in the form of management as economic and social factors assume greater importance. In the Northeast Atlantic all these changes are taking place very rapidly and it is by no means clear what will emerge. The sections which follow are therefore partly concerned with describing and analyzing the changes in methods and institutions which have taken place and partly with predicting further changes or prescribing new methods and institutions (or in some cases emphasizing the value of existing ones).

3.1 Use of Biological Models

There have been many valid criticisms in recent years of the use of MSY and other concepts derived from simple biological models as objectives of fisheries management (Roedel, 1975). In defence of the biological models and their optima it can be said that they have provided a basis for international agreement on fisheries regulation where more sophisticated and realistic models incorporating economic variables would have failed. For shared stocks this may still be the case, but in general it must be recognized that the biological limits to productivity are better regarded as one of the main constraints on a system whose goals are economic and social. In assessing the current state of a stock the biologist should determine:

1. What its size and spawning stock size are and whether this is sufficient to maintain a high, steady recruitment of young fish.

2. What the effects of varying the fishing mortality will be on the immediate and long-term catch and on the catch rate. Since the catch rate (e.g. catch per boat per month) is the major determinant of income, projections of it are needed for economic assessments.

3. Whether the exploitation pattern can be altered to improve the yield from the stock, e.g., by reducing mortality on juveniles in inshore areas and small mesh fisheries.

The biological components (i.e., growth, recruitment, mortality and migrations) are not affected by the new national boundaries, but the pattern of fishing may be and the possible effects of this need to be considered. For example, the distribution of fishing may be altered by the introduction of zone quotas and thus result in lower yields, because more young fish are caught. The pattern of fishing by distant water fleets may in some circumstances lead to higher yields than can be obtained by steady local effort because they can move in to harvest good year classes heavily close to their optimum size (Pope, 1973). If the stocks in a particular area become depleted then distant water fleets can move on to other areas and allow them to recover. Local fleets with no alternative livelihood may have to go on fishing and further deplete the stocks.

There may therefore be a case for retaining at least some mobile fishing effort, particularly for the exploitation of stocks with a high degree of variability. A proportion of the U.K. purse-seine and mid-water trawling fleet for pelagic species moves regularly from one area to another during the year, fishing on different stocks and species (mainly herring and mackerel).

Local fleets which remain in one area may achieve a similar result by switching from one species and type of gear to another during the year. For this reason and because there are biological interactions between species, the single species models generally used may give misleading results if they are summed to give the overall production for an area. The kind of regulation which is best for one species is not necessarily best for all and studies of the interactions have been proceeding for many years, but have produced few solutions (Gulland, 1975). The significance of these single species and multispecies models to the post-200 mile regime is that countries are now looking at the longer term planning of fleet size and composition which they will need to exploit their EEZ's. In order to do so they will need to look at all the resources available and how the vessels will affect the whole species complex. For this purpose single species models on their own may not be adequate (Brander, 1977).

3.2 Use of Economic Models

The addition of economic factors greatly widens the scope of the systems being modelled. Economic models can be designed to look at the most efficient way of exploiting the range of resources available to the fleets in a particular area, taking account of the biological production and the costs of fishing. The costs and values assigned to the different inputs and outputs in an economic model are not simply amounts of money, but incorporate attitudes towards social organization and a multitude of political choices on such things as subsidies, exchange rates and employment. For this reason economic models have not been used in international negotiations on regulation and allocation. It is impossible to construct a realistic economic model of a resource and its exploitation which is independent of these attitudes and choices and which provides an "objective" means of determining economically efficient management measures or an economically optimal allocation. Nevertheless, the construction of an economic model may help to identify the sources of disagreement between countries and focus the argument.

One such disagreement concerns the exploitation of sole in the Bristol Channel which is caught mainly as a directed fishery by Belgian beam trawlers and as part of a mixed catch by the local U.K. fleet. The U.K. fishermen claim that the sole, a high value species, is overfished, but a biological assessment of the stock does not support this claim (i.e. fishing mortality is below that needed for MSY). An economic explanation may be given for their claim and may show ways of resolving the argument. Because of the directed fishery on sole the catch rate has fallen and the local mixed fishery is no longer profitable. If the sole fishery by beam trawlers continues then the local fleet may have to stop fishing (their effort in the Bristol Channel has already fallen) and as a result the other species in the area might be underexploited. It may be possible to construct an economic model to show roughly how many beam trawlers can be allowed to fish in the area without making the local fleet unprofitable or what the combination of beam trawlers and local otter trawlers should be to maximize the yield in weight or gross value of all species.

There are at least two further important contributions which economic analyses and models can make to the management debate. The first concerns the rate of exploitation and the time stream of future benefits and here the use of discount rates enables us to compare the value of a catch at present with a future catch. For example when exploitation of a new resource starts, the stock biomass is high and there is an excess over the level needed for MSY. Should this excess be fished down as fast as possible or should it be used up over a number of years? (Clark, 1976 - Ch. 4). A second example is the case of the North Sea sole, which has a severely reduced biomass at present. Is it better to cut present catch drastically and allow the stock to recover quickly or to take somewhat higher catches now and allow a slower recovery? The use of discount rates to assign a present value to future catches provides useful guidance on the implications of different management options in these cases but should never be reviewed in isolation from the other constraints on the options. In many cases, particularly if high discount rates are used, the present value will be maximized by catching the whole stock as fast as possible and this is usually not an acceptable option.

The second important contribution of economic analysis concerns the methods which are used to regulate the rate of fishing.[1] To date these have included:

catch quotas
limitations on number and size of vessel
limitations on type of gear and number of operations of it
limitations on the time spent fishing
closed areas and closed seasons
fixed or variable licence or entry fees.

The advantages and shortcomings of these various methods have been extensively documented (Scott, 1970) and the main complaint about most is that because of them or in spite of them the resources of capital and manpower in fishing are used inefficiently. Since many of the regulations are specifically intended to reduce the rate of fishing by reducing the efficiency this is hardly surprising. There may be combinations of these regulations in force, often with an internationally agreed catch quota (limitation on output) being controlled nationally by means of some form of effort limitation (control on input). To use the example of the North Sea sole again, the Dutch controlled their catch quota by restricting the amount of time during each week that their beam trawlers were allowed to fish and by looking up the tickler chains which are used to make the beam trawls efficient at catching soles. The whole problem of effective methods of regulation and control is being learned by painful experience at the moment and the economic analyses provide the clearest way of understanding the successes and failures and of devising better methods.

Finally, one calculation which has become of great interest since the advent of extended national jurisdiction, is the balance between the additional costs of enforcement and management and the benefits to the country which are likely to ensue. An example of this kind of calculation for the U.S.A. (Bell, 1977) indicates that the net benefits may be very small and, taking into account the potentially enormous costs of enforcing a 200 mile limit effectively, this is not surprising. In general the costs of enforcement will be related to the kind of regulation and level of detail and the only way in which costs can be reduced is by raising the level of cooperation of the international and local industries.

3.3 Management Institutions

There are a number of ways and institutions for resolving international fisheries problems including international treaties, international commissions, global conferences, unilateral appropriation and force. Since the unilateral declaration of a 200 mile limit by Iceland in 1975 and successful resistance to attempts to invalidate it by force, the changes in the management institutions for the Northeast Atlantic have been rapid and are still continuing. By the beginning of 1977 most countries had declared 200 mile limits and have begun a length series of bilateral negotiations on the allocation of shared resources between coastal states and the trading of fishing rights with third countries. In most cases "historic" fishing rights were either denied completely or were scheduled to be phased out over the next few years. The role of NEAFC in setting and enforcing regulatory measures such as TAC's and mesh size has been virtually eliminated, although over much of the area there is nothing to take its place and most conservation measures have simply been "frozen" over the last year. The future role of NEAFC is unclear and its abandonment before a workable successor became available has probably not helped the cause of fisheries management.

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[1] There are of course other management measures in force in the Northeast Atlantic such as mesh size restrictions and minimum landing size, but these do not control the rate of fishing directly.

The greatest obstacle to the formation of a successor to NEAFC or to the completion of bilateral negotiations between the coastal states is that the EEC countries are committed to a common fisheries policy with mutual access in each others waters, but have not, to date, reached agreement on the form of this policy. The U.K. and Ireland in whose EEZ's most of the fish are, want to have some national control over the fishing activity of other member states as well as being given special rights during the allocation of catch quotas. There are political aspects, such as recognition of the EEC by the Soviet Union, which have further complicated the situation and have given it quite a disproportionate importance. Until this political traffic jam is sorted out there is little prospect of any consideration being given to management problems which have meanwhile arisen. One of the effects of the long delay in reaching agreement has been that countries both within and outside the EEC have tended to adopt unilateral conservation measures to protect their own interests and this in turn has made the search for agreement more difficult.

There have been changes in the management of fisheries matters within many countries as well as at the international level. As distant water fleets have been cut back many of the big fishing firms in the U.K. have turned to middle and near water fishing. The producer organizations and other organizations representing inshore fishermen have become more powerful and have in some cases taken on the responsibility of regulating the activity of their members in order to ensure an orderly and equitable sharing of quotas. This kind of self regulation by the industry is a very welcome development, but there have been complaints from fish merchants and processers that they too should have a say, since their interests may be different from those of the primary producers. The same case can be made to support the interests of the customers to ensure that the benefits of the national fisheries resources do not go only to one part of the community.

3.4 Provision of Scientific Advice

It is probably fortunate that the scientific advisory body for the Northeast Atlantic, ICES, is independent of the management body and has not been affected to the same extent by the changes in management regime. As well as providing advice on fisheries management and marine pollution ICES coordinates and publishes a wide range of general oceanographic and marine biological studies. It is supported by contributions from member states and NEAFC and its working groups are open to scientists from all the member states. There have been suggestions that the EEC in particular could obtain its own management advice internally and that ICES is no longer necessary, but these suggestions have been resisted. Since the principal reason advanced for having a common fisheries policy within the EEC is that stocks are shared by member states and cannot be managed separately it seems perverse not to apply the same reasoning to the scientific advice and make use of the existing forum for studying all shared stocks, whether in EEC waters or not.

The system for obtaining scientific advice on management used to be that NEAFC would ask the Liaison Committee of ICES to provide guidance on mesh regulations, TAC's and other matters. The Liaison Committee would pass on these requests to working groups of scientists from member countries of ICES and would bring their reports together in a single report to NEAFC. Thus, the Liaison Committee acted as a filter and a check on the scientific advice. During the last year, the working groups have been asked to supply biological information and catch statistics relevant to the allocation issue and the Liaison Committee report has been used as a basis for bilateral negotiations on TAC's and also on allocation. With the reduction in the role of NEAFC there is no body to specify what scientific advice is required for the future and instead the working groups have been asked to provide the "usual range" of advice, although the recipient of the advice is not specified. In a few cases over the past year ICES has been asked to call *ad hoc* groups to advise on particular issues but this is an unpopular and disruptive expedient. ICES will have to adapt to the changing management regime, but since it is not at all clear what this regime will be the adaptations cannot take place yet.

One important change which has taken place already is that the Liaison Committee has been replaced by the Advisory Committee on Fisheries Management (ACFM) which consists of national representatives. There is considerable concern within the scientific community that the independent status of the scientific advice will be compromised by introducing national viewpoints and also by asking scientific groups to provide the kind of advice needed for settling allocation issues. There are two possible courses of action:

1. To try to isolate the scientific (and in this context one is only talking about biological) aspects of fisheries management and to refuse to consider problems such as allocation.

2. To acknowledge that national interests (and other sectional interests) are part of the fisheries management problems and to try to incorporate them in an objective way.

The danger of the former approach is that the scientific advice will be ignored, because it does not answer the management questions posed. The second alternative can lead to partisan advice or disagreements within the groups stemming from different national viewpoints. Since the working groups exist to consider practical rather than scientific problems it seems right that they should adopt the second approach but should, at the same time, try to identify and acknowledge the sectional interests. Many scientists have to face the problem of recognizing and allowing for sectional interests in any case, since as well as sitting on ICES working groups they will often be called on to advise their national fisheries administrations.

One of the other major functions of ICES is to compile and publish the statistics on catch and effort for the Northeast Atlantic region and this too has been affected by the extension of limits. On the positive side there are now stricter checks on the catch statistics for enforcement purposes and the gradual introduction of licences and logbooks should lead to better effort statistics becoming available. On the negative side, there are the greater incentives to misreport catches in order to evade restrictions or to secure a larger "historic" share of stocks not yet subject to quotas. In some cases countries have withheld details of their catch and fishing effort so as not to prejudice negotiating positions and there have been restrictions on the exchange of information at the scientific working groups.

3.5 The Need for New Institutions

There is a vacuum in fisheries management affecting large areas of the Northeast Atlantic at present. Iceland and Faroe are able to regulate their stocks unilaterally for the most part and the USSR and Norway have a limited bilateral agreement, but there is no new convention for NEAFC yet and the EEC is in disarray. The powers of regulation and control have passed to the coastal states, but bilateral negotiations or an international forum are still needed to produce management policies for shared stocks and to resolve problems of allocation. The elaboration of management policies and the problems of allocation are likely to require continuous reviewing and it is therefore worth considering the establishment of regional management councils to advise the coastal states on these matters. The regional management councils could be formed under NEAFC or might, for certain areas, be convened by a coastal state or larger grouping (e.g., EEC). The area covered by each regional council would correspond as far as possible with stock boundaries and the grouping of fishing fleets (e.g., Bay of Biscay, North Sea), since the trend at present is towards local fleets catching a variety of species in a defined area. The regional councils would thus be considering a relatively self-contained set of stocks and would be dealing with fleets and industries with a high degree of common interest. The whole exercise of trying to describe a structure and function for such councils is of course highly speculative, but there are several factors which give the idea some substance and urgency.

1. The United States under its Fishery Conservation and Management Act of 1976 has established eight such regional fisheries management councils covering the area of its EEZ. The role, organization and performance of these councils and the problems they have encountered during their first year are described in two extremely interesting and informative articles by Knight (1978) and Kelly (1978). There is clearly a great deal to be learned from the U.S. experience in this field.

2. With the rapid increase in the number of species and areas being managed the old institutions of NEAFC with annual or twice yearly meetings would be quite unable to cope. In the past the agenda for meetings was rarely completed and many issues were left unresolved and stocks unregulated as a result. Since extra committees or councils of some kind are inevitable it would seem sensible to organise them on an area basis in order to incorporate knowledge of the local biological, industrial and political situation.

3. Although one of the main reasons for extending limits was to reduce the fishing pressure on several heavily exploited stocks the reduction in effort should proceed in a controlled way so that, for example, the social and economic effects of loss of distant water fleets can be absorbed gradually and the fleet which is left is of the right size and type to exploit the available resources. Given the present uncertainty over fisheries management and the rapid increase in controls of all kinds, it is quite possible that effort will fall more quickly than is justified from an economic, if not from a biological, point of view (e.g., the case quoted for the North Sea sole stock). The regional management councils would provide a forum in which this kind of longer term issue could be discussed. There is a growing realization that one cannot manage the individual stocks in an area in isolation from each other and for certain areas it is by no means evident that the fishing effort on the whole complex of stocks is in fact grossly excessive in spite of what one is led to believe by single species yield per recruit models (Brander, op.cit.).

Before going on to describe a possible framework for the regional council in more detail, a list of some of the objectives and attributes is given:

1. Harmonious and balanced development of the fishing industry.

2. Rational exploitation of fisheries.

3. Increased productivity through restructuring of fishing fleets and developments in technology.

4. Fair standard of living for fishermen.

5. Special consideration for areas heavily dependent on fishing.

Attributes

The regional council should:

- be able to respond swiftly to requests
- anticipate, not react to events
- operate from an acceptable data basis
- encourage economic efficiency in the process of management (including its own costs in relation to the value of the fishery)
- be seen to be open, rational fair and effective.

The regional council would include representatives of all countries with fishing interests in the area and would report to national governments or whatever form of management authority existed for the area. The regional council would have a scientific working group to assist it and two aspects of the timing of the meetings are important, at least if annual regulations are being set. The first is that the meeting of the scientific group should overlap with the council so that they would be available to assess the likely effects of the various proposals put forward. The second is that the quality of the stock predictions made by the scientists for the coming year depends to a significant degree on how late in the year the meeting takes place, because more data, particularly on the size of recruiting year classes, will be available. A block diagram of the timing and relationship between the various groups is given in Figure 2.

The scientific working group, set up by ICES, would deal with all species and would integrate its suggested management measures into a fishing strategy, which would take account of the existing fleet structure and pattern of fishing. Once the council has produced its proposals, the scientific group would complete a report to the ACFM of ICES, which would include an assessment of the likely effect of these proposals on the stocks in the area. By the time the ACFM met during the year it would also have the reaction of the management authority to the proposals and would produce a report which would:

a) Comment on and direct the scientific work carried out by its working groups.

b) Comment on the likely effects of the final proposals on fish stocks.

c) Summarize and interpret the reationale behind the management proposals for the benefit of the fishing industry, including an assessment of future trends in catch rate and regulations.

In this way ICES will continue to be concerned principally with the health of fish stocks, but it will also act as an informed critic of the management proposals and as a means of communicating these to the industry.

The argument has strayed somewhat from the original analysis of the effects on management of 200 mile limits, but in trying to show how a forum might be established for considering the wider issues raised for both short-term and long-term management of an area I have thought it worthwhile to sketch-in some ideas on the whole of the scientific and management structure.

4. REFERENCES

Note

Much of the information given in the section on stocks came from the appendices of 1977 ICES working group reports, which were prepared in response to a request from NEAFC; separate references to these reports are not listed here.

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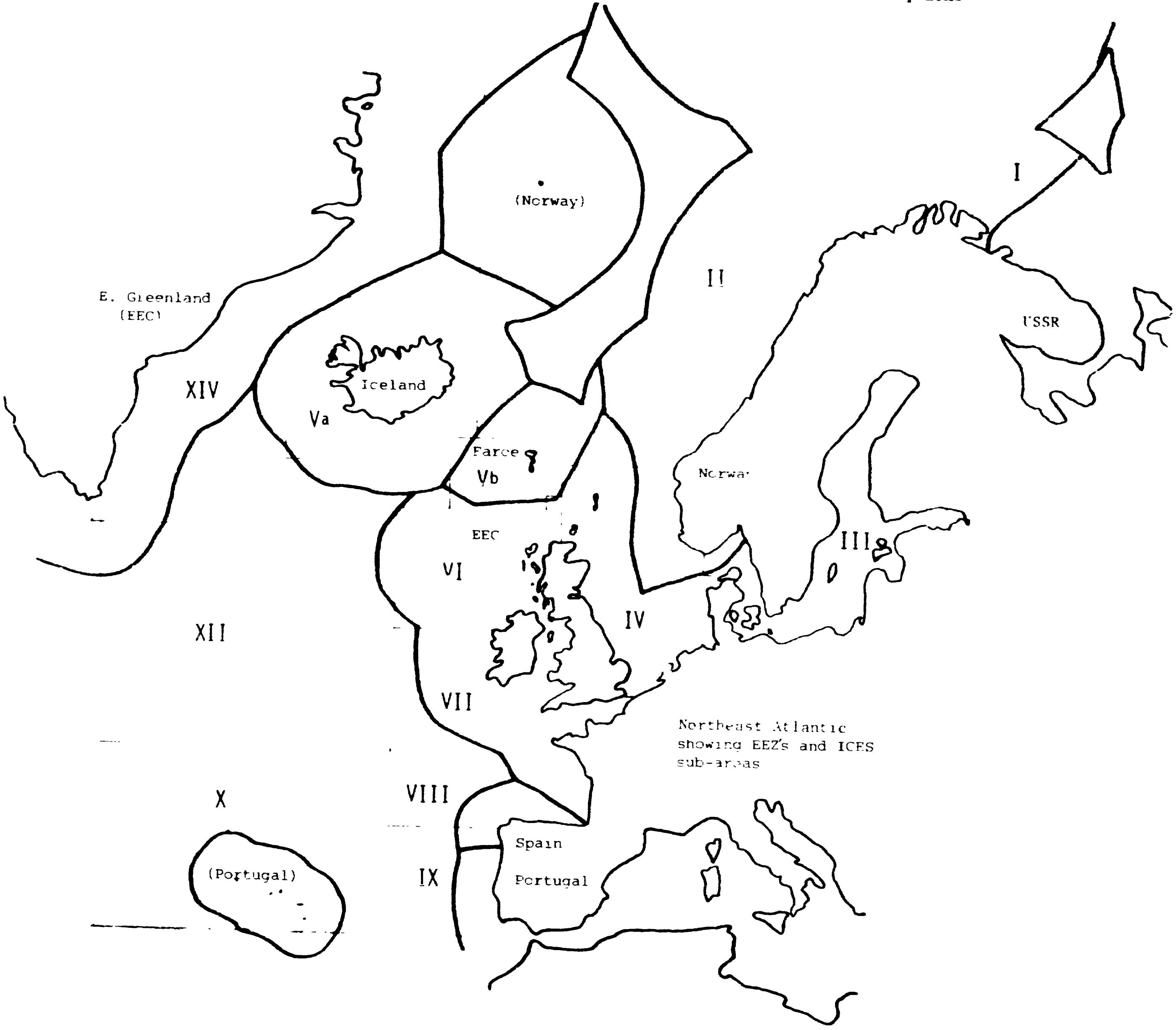
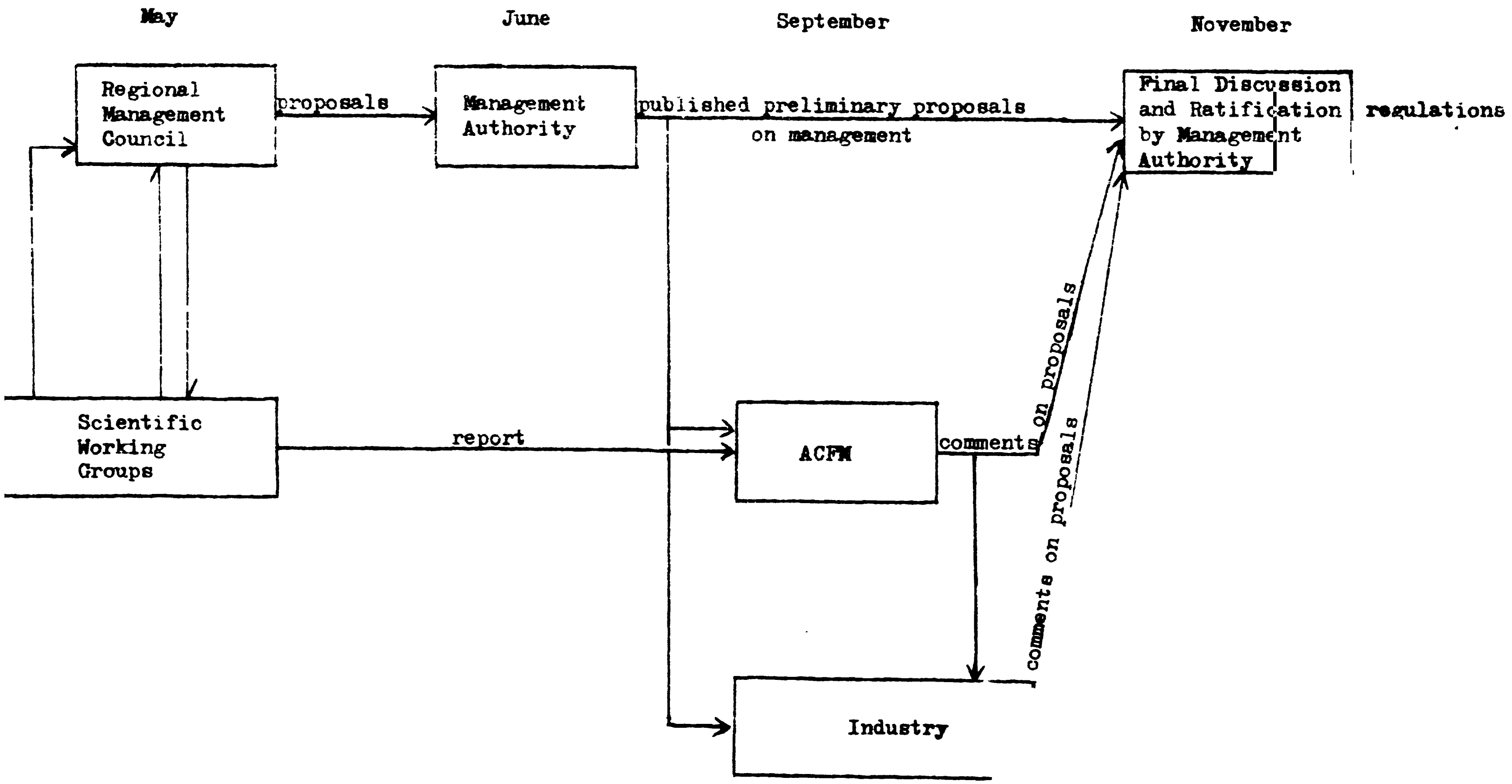
Figure 1. Northeast Atlantic, showing ICES sub-areas, and possible divisions of EEZ's under certain hypothetical assumptions



Northeast Atlantic showing EEZ's and ICES sub-areas

Figure 2. A possible structure and timetable for Regional Management Councils


May
June
September
November
Regional Management Council
proposals
Management Authority
published preliminary proposals on management
Final Discussion and Ratification by Management Authority
regulations
Scientific Working Groups
report
ACFM
comments on proposals
Industry
comments on proposals

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